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# CBT/OTEP 445 Head and Spine Emergencies

print version of EMS Online Course  
[www.emsonline.net](http://www.emsonline.net)

## Head and Spine Injuries

# Introduction

Your role as an EMT is to make things better. At a minimum you want to avoid making things worse. This is particularly important when it comes to head and spine injuries. Because the brain and spinal cord are essential to living a normal life, your objective is to identify potential brain and spinal cord injuries and do everything possible to stabilize a patient so that no further injury occurs prior to arrival at a hospital.



**Second only to ABCs and major bleeding, head and spine immobilization is the most important consideration to make as an EMT.**

This module will cover assessment of head and spine injuries. It will also help you evaluate patients based on the mechanism of injury and clinical indicators, and help you consider taking and maintaining spine immobilization.

### Before You Begin

This is a continuing education and recertification course for EMTs. It covers fundamental EMT-Basic concepts and terminology as well as advanced material. We highly recommend completing the case studies and practice exam before completing the exam. We also recommend that you review an EMT textbook chapter covering diabetic emergencies as a refresher before taking the exam; for example: Chapter 30 in *Emergency Care and Transportation of the Sick and Injured*, 9th edition (AAOS).

### Practical Skills

To receive CBT or OTEP credit for this course a trained skills evaluator must evaluate your ability to perform the following hands-on practical skills:

- control of major bleeding
- jaw thrust where indicated
- spine immobilization

Go to the Downloads section of EMS Online to download the skills checklist for this course (click "2006 CBT/OTEP Skills Checklists").

### Course Objectives

After completing this module on head and spine injuries, you will be able to:

1. Identify the protective structures of the skeletal system.
2. Identify how a CMS exam reflects the status of the nervous system.
3. Identify the signs and symptoms of a spine injury.
4. Identify the steps for emergency care of a spine injury.
5. Identify signs and symptoms of a head injury.
6. Identify the steps for emergency care of a head injury.
7. Identify key principles of rapid extrication.
8. Identify situations when a helmet should be removed.
9. Identify the key principles and steps of helmet removal.

## Head and Spine Injuries

# Terms

### Terms You Should Know

**Battle's sign** - Bruising discoloration over the mastoid bone just behind the ear). It indicates a basilar skull fracture.

**central nervous system (CNS)** - The main part of the nervous system that includes the cerebrum, cerebellum, brain stem, and spinal cord. It does not include the peripheral nerves.

**cerebrospinal fluid (CSF)** - Clear fluid that surrounds and protects the brain and spinal cord. It provides a cushion from blows to the head.

**clonic** - Repetitive muscular activity or spasms which occur during a generalized seizure. These cease once the seizure is over.

**ecchymosis** - The purple or black-and-blue area resulting from a bruise.

**neutral position** - A position where the patient's spine is at no stress. In other words, it is not flexed, extended, or rotated.

**peripheral nervous system** - The peripheral nervous system includes the nerves from the spinal cord to the body's organs, skin, and muscles. It includes sensory and motor nerves coming from the spinal cord and brain stem.

**raccoon eyes** - Bruising under the eyes which resemble the appearance of a raccoon. It often indicates skull fracture. The medical term is periorbital ecchymosis.

**tonic** - Rigid muscle contractions that occur with generalized seizures. They stop when the seizure is over.

### New Terms

**arachnoid** - A delicate membrane that encloses the spinal cord and brain and lies between the pia mater and dura mater.

**dura mater** - The tough fibrous membrane covering the brain and the spinal cord and lining the inner surface of the skull. It is the outermost of the three meninges that surround the brain and spinal cord.

**pia mater** - The fine vascular membrane that closely envelops the brain and spinal cord under the arachnoid and the dura mater.

## Head and Spine Injuries

# Resources

### Spinal Cord Injury Network

<http://www.spinalcord.uab.edu/>

### Worlds Wheelchair Culture

<http://www.paralinks.net/>

### Spinal Cord Dysfunction

Complementary and Alternative Medicine

<http://main.uab.edu/show.asp?durki=13964>

### Spinal Cord Injury Resource Center

<http://www.spinalinjury.net/>

### Neurotrauma Law Nexus

Information for understanding the legal issues involved in brain injury and spinal cord injury cases.

<http://www.neurolaw.com>

### P. A. Pearls from the E. R.

[http://www.webmedtechnology.com/papearls/monthly\\_index.htm](http://www.webmedtechnology.com/papearls/monthly_index.htm)

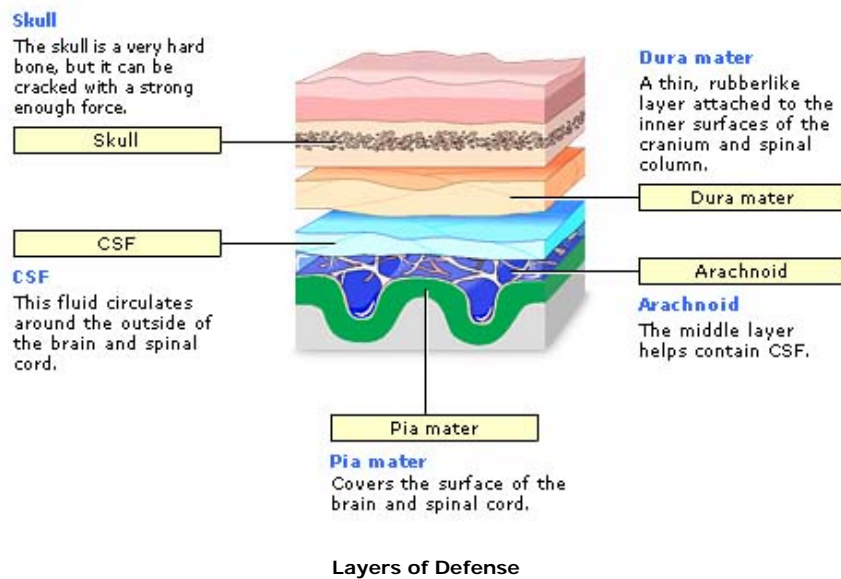
## Head and Spine Injuries

# Head

To protect our most vital organs from injury, our bodies have several layers of defense. The first line of defense is the meninges which surrounds both the brain and spinal cord. The meninges contain three distinct layers: dura mater, arachnoid, and pia mater.

The space between the pia mater and the arachnoid is filled with cerebrospinal fluid (CSF).

The next line of defense for the brain is the skull.



## Head and Spine Injuries

# Ears

Cerebrospinal fluid (CSF) surrounds the brain and acts like a shock absorber. The fluid is held within the layers of the meninges so that it doesn't leak away.

In some head injuries, CSF will drain from the patient's ears or nose. This is an important piece of information to note in the Subjective section of the incident report form.



**Battle's signs**



**Battle's signs, blood with CSF**

## Head and Spine Injuries

# Eyes

The pupils can be described as the "gateway to the brain" because the nerves that control dilation and constriction are very sensitive to pressure within the skull. When the brain is injured it can swell in size. Since the skull is a closed space there is little room for expansion.

When you beam a penlight into the eye, the pupil should naturally constrict. An early and important sign of increased intracranial pressure is when a pupil does NOT constrict. Unequal pupil size may be an indication of increased pressure on one side of the brain.

### Pupil Check

You should check pupils for size and reaction to light as part of your patient assessment. Checking the pupil size should become part of your ongoing assessment especially for an unconscious patient. Note your findings on the incident report form (for example, "PEARL" means "pupils equal and reactive to light").

BLS providers can assess increased pressure in the brain by noting changes in:

- physical signs
- vital signs
- behavior
- respiratory rate
- presence of CSF

## Head and Spine Injuries

# Neck

Head and spine injuries often go hand in hand. If you encounter a serious head injury, assume there are injuries to the spine--especially the cervical spine.

Most spinal injuries are a result of:

- motor vehicle accidents
- falls
- direct trauma



**Completely distracted cervical spine**

Spinal cord injuries may result in impaired respiratory effort. For example, you may see diaphragmatic breathing. Be prepared to provide support for ventilations.

When performing a physical exam, palpate the spinous process starting at the neck and working down. These are the bony parts sticking out along the back of the neck. Note any deformity, alignment, or tenderness when palpating the neck before you apply the c-collar.

## Head and Spine Injuries

**Throat****Common Head and Face Injuries**

<b>Scalp Lacerations</b>	<ul style="list-style-type: none"> <li>• Can cause heavy arterial bleeding (spurting)</li> <li>• Direct pressure is the best way to manage</li> </ul>
<b>Skull Fractures</b>	<ul style="list-style-type: none"> <li>• Soft tissue swelling makes detection difficult</li> <li>• Cover with sterile dressing</li> <li>• Do not attempt to push contents back in</li> </ul>
<b>Concussion</b>	<ul style="list-style-type: none"> <li>• Can cause temporary loss of consciousness</li> <li>• No permanent damage</li> <li>• Often causes loss of memory of preceding events</li> </ul>
<b>Contusion</b>	<ul style="list-style-type: none"> <li>• Bruise to the brain</li> <li>• Can cause permanent damage</li> <li>• Detected only by CT or MRI scan</li> </ul>
<b>Nose Injuries</b>	<ul style="list-style-type: none"> <li>• Most injured area on the face</li> <li>• Swelling may mask more serious injuries</li> <li>• Apply cold compress, keep head higher than body</li> </ul>

## Head and Spine Injuries

# Spine

The bones in the spinal column are stabilized by muscles and ligaments that allow the spine to bend and twist to some degree.

The nerve bundles in the spinal cord are MUCH more vulnerable to injury with side-to-side movement than longitudinal movement; therefore your main concern when moving a patient is keeping the spinal column in line.



**Attempt to move ALL patients with potential spine injuries longitudinally rather than sideways.**

This helps reduce the chances of pinching a nerve bundle.

## Spinal Cord Injuries

A spinal cord injury usually begins with a sudden, traumatic blow to the head or spine that may cause fractures or dislocate vertebrae or disrupt the spinal cord. The damage begins at the moment of injury when displaced bone fragments, disc material, or ligaments bruise or tear into spinal cord tissue. Most injuries to the spinal cord don't completely sever it. The injured tissue may continue to swell causing further neurological deficits.

If the central part of the spinal canal is sufficiently disrupted, bent, or broken, the spinal cord will be damaged. The location and degree of damage will determine the location and degree of paralysis. For example, a lower lumbar injury may paralyze a person from the waist down whereas an injury as high as the cervical vertebrae can cause them to be quadriplegic, or unable to use any of their limbs.

## Head and Spine Injuries

# Circulation

A correctly performed circulatory, motor and sensory (CMS) exam is an indicator of the level of vascular and neurological function to the extremity.

### Shock

Poor circulation may be caused by shock or damaged blood vessels. A patient with an isolated head injury should not exhibit signs of shock.

In general, shock due to blood loss results in a fast pulse and falling blood pressure. Increasing intracranial pressure typically results in a slow pulse and a rising blood pressure.

If a head-injured patient shows signs of shock, you need to suspect other internal injuries.

## Head and Spine Injuries

# Motor Sensory Function

Say you are reaching for a potato. Your brain thinks "lunch" and sends a signal to the spinal cord. The signal then travels through the motor nerve to the muscles. The muscles execute and you grab the potato.

Nerves that extend from the spinal cord that control the muscles of the body are called motor nerves (think: **m**otor nerves **m**ove **m**uscle).

Motor nerves carry information from the central nervous system to the muscles.

Remember your potato? Let's say the potato is very hot.

The sensory cells in your skin connected to the nerve send a signal back to the spinal cord that "tells" you to drop the potato.

Sensory nerves allow sensations of feeling, hot or cold, and position that travel back to the spinal cord and up to the brain. Sensory nerves carry information from the body to the brain via the spinal cord (think: **s**ensory nerves **s**end **s**ignals).

A thorough CMS exam will distinguish between the two types of nerves. A patient unable to squeeze both of your hands is experiencing a loss of motor function whereas a patient unable to feel you touching the side of their foot is experiencing a loss of sensation, or sensory function.

## Head and Spine Injuries

# Assessment

As an EMS provider you are not expected necessarily to make a diagnosis of all underlying illness or injuries that a patient may have.

However, you are expected to completely perform an assessment to determine whether or not a patient is SICK (physiologically unstable based on key clinical indicators) or NOT SICK (physiologically stable based on key clinical indicators).

These early decisions will help determine the level of care each patient requires.

## Mechanism of Injury

Most spinal injuries are not apparent through observation. Mechanism of injury is an important factor in assessing the potential for a spinal injury. When evaluating the MOI, look for evidence that a significant force was delivered to the body. For example, look for damage to vehicles and other physical evidence.

## Head and Spine Injuries

# Level of Consciousness

A change in level of consciousness (LOC) is the single most important observation that you can make in assessing the severity of brain injury. If you suspect a head injury, record a baseline assessment using the AVPU scale and record the time.

Consider asking these questions when assessing level of consciousness and determining if there are neurological deficits.

- Is the patient thinking and speaking clearly?
- Does the patient understand you completely?
- Can the patient move all his limbs?
- Does the patient have normal sensations when you touch the skin?

Most important: Is the patient's neurological status stable or deteriorating?

## Documenting LOC

With suspected head injuries you should note the patient's level of consciousness in simple terms and the time. The ER staff will need to know if and when the patient lost consciousness. For example, the flow chart portion of your incident report may read:

2312 - A/O x 2: confused about date and time

2317 - A/O x 1: isn't sure where he is/how he got here

2322 - responds to pain: began to mumble and stopped answering simple questions

## Head and Spine Injuries

# Treatment

For suspected head or spine injuries, your decisions will follow a specific path and depend on a good initial assessment.

Your assessment will guide you to a variety of treatment options such as spinal immobilization, airway management, and oxygen administration.

Key points for treating a spinal injury include:

- ensure an open airway (use jaw thrust)
- provide manual stabilization in a neutral, in-line position
- check and document CMS before AND after immobilization

Key points for treating a head-injured patient include:

- ensure an open airway
- prepare for vomiting
- monitor LOC closely

Other treatment suggestions include providing adequate ventilation and high flow oxygen for the head-injured patient.

## Head and Spine Injuries

# Immobilization

The purpose of spine immobilization is to prevent further injury. To effectively immobilize the spine, you must immobilize the trunk, legs, arms and lastly, the head. Remember, there are risks for the immobilized patient that includes inability to protect airway, discomfort, and pain.

If a patient is unconscious and you do not know the mechanism of injury, you should assume that he or she has a spinal injury.

Once you have initiated immobilization, it should be continued until the patient is delivered to the next level of care. EMS personnel (in King County) should not "clear" patients with head, neck, or spine injuries, or remove immobilization after it has been applied.

## Immobilization Indicators

Immobilization is necessary for any one of the following situations:

- significant mechanism of injury
- complaint of pain of neck or back with or without movement
- altered level of consciousness
- history of loss of consciousness
- intoxication with alcohol and/or drugs
- very young or elderly
- significant injury above femurs
- significant acceleration/deceleration injury
- diving accidents
- falls greater than 10 feet
- gunshot wounds to neck, chest, abdomen, pelvis, or groin
- stab wound close to the spine
- significant head injury
- drowning victim of unknown cause
- electrocution and explosion victims
- complaint of paralysis, numbness, weakness, tingling, or burning sensation of the arms or legs after a traumatic injury

## Precautions for Pregnant Patients

Another precaution you may need to take for the pregnant patient is to tilt the right side of the backboard up 6 to 8 inches as you look at your patient anatomically the left side should be down. This should alleviate symptoms of supine hypotension syndrome where the pressure of the fetus compresses the mother's vena cava.

## Head and Spine Injuries

# Manual Stabilization

Align the patient's neck to a neutral, in-line position unless you encounter new pain, new numbness, tingling or weakness, new compromise of airway or ventilation or resistance. Apply cervical collar and backboard.

If you are unable to realign the neck, then secure the patient in the position found.

**Head and Spine Injuries****Rapid Extrication**

There are some situations when you may need to get someone out of a vehicle or from behind a piece of furniture, or some other place in order to provide care. These situations will require your best judgment but the following are some guidelines.

Perform a rapid extrication when:

Guideline	Example
1. Patient's life is in immediate danger.	The patient's airway is obstructed or they are bleeding profusely.
2. Your own safety is compromised.	You are inside a vehicle maintaining spine immobilization and a part of the vehicle catches on fire.
3. There is a patient in more serious condition.	You are caring for a patient with suspected spine injury and witness a different patient go into cardiac arrest.

As stated earlier, it is crucial that you make every effort to pull longitudinally or, along the axis of the patient's body avoiding any sharp movements from side to side.

## Head and Spine Injuries

# Guidelines

Leave helmets ON unless:

1. They prevent maintenance of the head / neck / spine in a neutral, in-line position

**OR**

2. The patient has:

- Nausea/vomiting
- Shortness of breath or respiratory problems
- Facial trauma
- An altered level of consciousness
- Deterioration of vital signs

Helmets that protrude in back may require removal to place patient on a backboard and maintain a neutral, in-line position.

You may be able to evaluate a patient wearing a football helmet by simply removing the face mask. If you remove the helmet for the reasons above, you **MUST** maintain a neutral, in-line position by either:

- removing the shoulder pads as well, or
- by padding under the head and lower back.



**Important: In the event of cardiac arrest, everything comes off as carefully as possible.**

## Head and Spine Injuries

# Removal

If a helmet needs to be removed, two rescuers should:

- remove face guard (for football helmets)
- remove (or cut) chinstrap
- stabilize neck and head
- remove helmet while stabilizing head, and apply cervical collar and backboard.

## Head and Spine Injuries

# Summary

The following key points were covered in this module:

The **brain and spinal cord** are essential to normal life. Therefore they are well-protected by the skull and the bony vertebrae.

Being able to identify potential brain and spinal cord injuries as well as do everything possible to stabilize the patient is the primary objective of EMS providers.

Decisions that you will have to make if you suspect a head or spine injury include:

- What is the mechanism of injury?
- Is ALS indicated?
- Based on MOI, is c-spine immobilization necessary?
- Is my patient breathing and if so, how well?
- What is the mental status of my patient?
- Do I need to perform rapid extrication?
- Should I remove this patient's helmet?

Checking CMS **before and after** applying any kind of splint or immobilization is a critical step in providing pre-hospital care in the field.

In the course of your career you may see a variety of head and spine injuries. An understanding of basic skeletal anatomy and being able to quickly recognize the severity of the injury will help guide your decisions in determining the appropriate treatment options in providing pre-hospital care.